SPECIFICATION

SPILL CONTAINMENT SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application Serial No. 09/428,192, filed on October 27, 1999, which is fully incorporated herein by reference.

US. PAT # 6308728

FIELD OF THE INVENTION

The field of the invention is spill containment systems and methods, and more particularly, is systems and methods for containing, neutralizing and/or monitoring spills from batteries or other devices.

BACKGROUND OF THE INVENTION

In our industrial society, devices often contain substances that may leak or spill undesirably onto other devices, personnel, or the environment. For example, batteries may be stored on battery racks where the batteries serve as a backup power supply for data communication centers and computers. These batteries may contain acid that may leak or spill onto other batteries, cables, equipment, and other devices as well as personnel, thereby posing a hazard to people and property. Sulfuric acid, commonly found in batteries, is an extremely hazardous material regulated by the federal, state and local governments. With respect to batteries, Article 64 of the Uniform Building Code requires a four-inch high containment barrier with an acid neutralization capability to a pH of 7-9. Similarly, other devices may need

containment systems. Such devices include but are not limited to air conditioning units that may drip water from condensation or leak freon, or water heaters that may leak water.

Regardless of the device and the substance that may leak, it is desirable to contain leaks and spills. It is further desirable to neutralize and absorb the leaks and spills to prevent the leaks and spills from spreading. Finally, it is desirable to have a system that not only detects leaks, but also indicates whether a leak has occurred.

SUMMARY OF THE INVENTION

A first, separate aspect of the present invention is a containment system that includes a containment rail system that defines an area, a liner placed within the area of the containment rail system and a material placed in the liner to absorb and/or neutralize the spilled substance. This system safely contains spills from devices.

A second, separate aspect of the present invention is a containment system that is modular and capable of being built in a variety of sizes and shapes.

A third, separate aspect of the present invention is a containment system that is resistant to damage from the spilled substance.

A fourth, separate aspect of the present invention is a containment system having a liner made of polyvinylchloride (PVC) so as to be resistant to corrosion from acids spilled

from a battery.

A fifth, separate aspect of the present invention is a containment system that uses materials to neutralize and absorb spilled substances.

A sixth, separate aspect of the present invention is a containment system that detects whether there is a spill from a device.

A seventh, separate aspect of the present invention is a containment system that alerts a user or system whether there is a spill from a device.

An eighth, separate aspect of the present invention is a containment system that includes a polyester web fiber coated with PVC . This liner provides corners which may be di-electrically ~~electically~~ welded or thermal welded for system integrity.

A ninth, separate aspect of the invention is any of the foregoing aspects, singly or in combination.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a spill containment system for stationary batteries.

Figure 2 is a front view of the battery spill containment system of Figure 1.

Figure 3 is a side view of the battery spill containment system of Figure 1.

Figure 4 is an exploded piece-part drawing of the major

components of a battery spill containment system and a battery rack.

Figure 5 is an exploded piece-part drawing of a battery spill containment system.

Figure 6 is a battery spill containment system formed in a rectangular shape.

Figure 7 is a battery spill containment system formed in another rectangular shape.

Figure 8 is a battery spill containment system formed in yet another rectangular shape.

Figure 9 is a battery spill containment system formed in an L-shape.

Figure 10 is a battery spill containment system formed in a U-shape.

Figure 11 is a battery spill containment system formed in another shape.

Figure 12 is a perspective view of a pillow.

Figure 13 is a perspective view of a sock.

Figure 14 is an exploded piece-part drawing of a battery spill containment system.

Figure 15 is an exploded piece-part drawing of a battery spill containment system that uses a pad and grid which sits underneath batteries.

Figure 16 is a drawing of a pad.

Figure 17 is a perspective view of a containment rail system.

Figure 18 is a front edge view of the containment rail system of Figure 17.

Figure 19 is a top view of the containment rail system of Figure 17.

Figure 20 is a perspective view of a battery spill containment system with batteries.

Figure 21 is an exploded piece-part view of a battery spill containment system, a leak detection device and a battery rack.

Figure 22 is a perspective view of a containment rail.

Figure 23 is a side edge view of the containment rail of Figure 22.

Figure 24 is a front view of the containment rail of Figure 22.

Figure 25 is a perspective view of an adjustable containment rail.

Figure 26 is a side edge view of the containment rail of Figure 25.

Figure 27 is a front view of the containment rail of Figure 25.

Figure 28 is a perspective view of a corner containment rail.

Figure 29 is a front view of the corner containment rail of Figure 28.

Figure 30 is a top view of the corner containment rail of Figure 28.

Figure 31 is a perspective view of a containment rail.

Figure 32 is a front view of the containment rail of Figure 31.

Figure 33 is a side view of the containment rail of Figure 31.

Figure 34 is a top view of the containment rail of Figure 31.

Figure 35 is a perspective view of a containment rail having a different dimension than the containment rail of Figure 31.

Figure 36 is a front view of the containment rail of Figure 35.

Figure 37 is a side view of the containment rail of Figure 35.

Figure 38 is a top view of the containment rail of Figure 35.

Figure 39 is a perspective view of a containment rail having a different dimension than the containment rails of Figures 31 and 35.

Figure 40 is a front view of the containment rail of

Figure 39.

Figure 41 is a side view of the containment rail of Figure 39.

Figure 42 is a top view of the containment rail of Figure 39.

Figure 43 is a perspective view of a containment rail having one flange.

Figure 44 is a front view of the containment rail of Figure 43.

Figure 45 is a side view of the containment rail of Figure 43.

Figure 46 is a top view of the containment rail of Figure 43.

Figure 47 is a perspective view of a containment rail having a notch.

Figure 48 is a front view of the containment rail of Figure 47.

Figure 49 is a side view of the containment rail of Figure 47.

Figure 50 is a top view of the containment rail of Figure 47.

Figure 51 is a perspective view of a containment rail with components to mount the rail to the floor.

Figure 52 is a perspective view of a containment rail

having slots.

Figure 53 is a front view of the containment rail of Figure 52.

Figure 54 is a side view of the containment rail of Figure 52.

Figure 55 is a top view of the containment rail of Figure 52.

Figure 56 is a perspective view of another embodiment of a containment rail having slots.

Figure 57 is a front view of the containment rail of Figure 56.

Figure 58 is a side view of the containment rail of Figure 56.

Figure 59 is a top view of the containment rail of Figure 56.

Figure 60 is a perspective view of yet another embodiment of containment rail having slots.

Figure 61 is a front view of the containment rail of Figure 60.

Figure 62 is a side view of the containment rail of Figure 60.

Figure 63 is a top view of the containment rail of Figure 60.

Figure 64 is a perspective view of a containment system

for batteries which illustrates the use of a liner and pillows.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The subject invention is a spill containment system and method.

Figure 1 is a perspective view of a spill containment system and battery rack for stationary batteries. The spill containment system 10 is mounted below a battery rack 12 that supports a plurality of batteries 14. The spill containment system 10 includes containment barriers 16 that are mounted to each other and to the floor with concrete floor anchors. Contained within the perimeter of the containment rails 16 are pillows 18. The pillows absorb spills and/or neutralize the spilled material. For example, in this particular embodiment of a containment system directed to battery spills, the pillows 18 absorb and neutralize the acid spilled from batteries 14 so that the acid does not leak onto the floor. The system prevents the acid from leaking onto the floor in order to prevent a hazardous situation for employees who may slip and fall, or burn themselves on the acid, as well as to prevent the acid from damaging nearby property and devices such as computers. Often the batteries serve as a backup energy source for computers, telecommunications and data

management systems, so it is important that spilled battery acid does not damage nearby cables and computers.

Figures 2 and 3 are the front and side views of the battery spill containment system of Figure 1 respectively.

Figure 4 is an exploded piece-part drawing of the major components of a battery spill containment system 10 and a battery rack 12. A containment rail system 20 is anchored to the floor. In this particular embodiment in Figure 4, the containment rail system 20 comprises a plurality of containment rails 16 that are mounted to each other and to the floor. In a preferred embodiment, the containment rails 16 are constructed out of 16 gauge sheet metal and coated with a material to make them resistant to and less likely to be damaged by the spilled material. For example, the containment rails 16 may be preferably coated with a layer of polyvinylchloride ("PVC") to a thickness of 10-15 millimeters or epoxy paint. It is further preferable that all surfaces of the containment rails 16 be coated by PVC or epoxy paint. For instance, even the holes in the containment rails 16 may be coated by PVC. Alternatively, the containment rails may be epoxy painted instead of PVC coated. Also alternatively, the components of each embodiment described in this patent specification may be fabricated out of metal, plastic, polypropylene, or other suitable materials. The containment

rail system may be a bright safety yellow per OSHA standards.

An optional corrosion resistant liner 24 may be inserted into the containment rail system 20. In particular, the corrosion resistant liner 24 is preferably fabricated of PVC with dielectric welded or thermal welded seams. For example, the material of the liner 24 may be coated with PVC on one side over a polyester web. As another example, the liner 24 may be fabricated out of a PVC thermoplastic material available as model C3000 (or C3 membrane) sold by Cooley Roofing Systems, Inc. (http://www.dupont.com/industrial-polymers/roofing/cooley.html) Model C3000 has been used in the roofing industry, but not in spill containment systems. As yet another example, the liner 24 may be fabricated out of a composite material such as a PVC-copolymer alloy composite. An example of a PVC-copolymer alloy is available from IB Roof Systems (http://www.Ibroof.com). Another example is a thirty-two ounce polyurethane available from FOSS Environmental and Infrastructure Inc. in Seattle, Washington (http://www.fossenv.com). An embodiment of the liner 24 may have a thickness, for example, of 50 to 80 millimeters. Certainly, other thicknesses are permissible.

Alternatively, the liner 24 may be fabricated out of vinyl or any other material that is resistant to damage from the spilled substance. The liner 24 is cut and welded at its

seams to form a liner of a desired shape. The liner 24 can be heat welded, or more preferably, dielectrically welded. Preferably, the liner 24 has an edge which rises about four inches to create a containment perimeter. The corrosion resistant liner 24 is preferably placed within the perimeter formed by the containment rail system 20, although the liner 24 could be mounted to the containment rail system 20 or be formed integral with the containment rail system 20. The battery rack 12 is then placed in the liner 24, mounted through the liner 24 to the containment rail system 20, or mounted through the liner 24 to the floor directly. Pillows 18 and socks 22 are optionally placed in the liner 24. If a liner 24 is not used, the optional pillows 18 and socks 22 may be placed within the perimeter formed by the containment rail system 20. Batteries may then be stored on the battery rack 12.

Figure 64 illustrates a battery spill containment system which includes a battery rack 12 having multiple shelves to hold the batteries 14. The system further includes a liner 24 placed within the perimeter formed by the containment rails 16. Spill neutralizing and absorbing pillows 18 are placed in the liner 24.

Figure 5 is an exploded piece-part drawing of a battery spill containment system that illustrates that the system may

be configured to have any desired shape or size. As can be seen in Figure 5, the containment rail system 20 comprises a variety of containment rails 16. Containment rails 16 themselves may have different sizes, shapes and configurations and are described in greater detail later in this patent specification. The corners and edges of each containment rail may be rounded if desired. As with any of the embodiments of any of the components or systems described in this patent specification, the dimensions, size, shape and/or configuration of each particular component or the entire system may be changed as desired for the particular application. For example, Figure 5 illustrates long containment rails 26, short containment rails 28, corner containment rails 30, and adjustable containment rails 32. The adjustable containment rails 32 have a plurality of mounting holes 34 that allow the installer to adjust the size, shape and configuration of the containment rail system 20 by selecting the mounting hole to use. In the particular embodiment of Figure 5, both pillows 18 and socks 22 are used. However, any of the systems described in this patent specification may use only pillows, only socks, neither pillows nor socks, or both.

Figure 6 is a battery spill containment system that is attached to a wall 36. The system is formed in a rectangular

shape. In the particular example of Figure 6, the containment rail system 20 comprises long containment rails 26, short containment rails 28 and notched containment rails 38. The purpose of the notch 110 is described below with respect to Figure 8.

Figure 7 is a battery spill containment system formed in another rectangular shape. In the particular example of Figure 7, the containment rail system 20 comprises long containment rails 26, short containment rails 28 and notched containment rails 38. The purpose of the notch 110 is described below with respect to Figure 8. Further, this example embodiment uses pillows 18 only.

Figure 8 is a battery spill containment system formed in yet another rectangular shape. This system is inverted such that the flanges protrude inward toward the rack. As a result, the inverted system has smooth outer surfaces which increases the aisle width and does not interfere with surrounding equipment or personnel. By contrast, for example, the system of Figure 7 has flanges 40 that jut outwardly. The notch 110 permits the building of an inverted containment rail system shown in Figure 8 where the exterior surfaces of the containment rail system are smooth. Smooth exterior surfaces may be desirable to reduce the hazard of tripping personnel who walk by the system. As illustrated, pillows 18 and socks

22 may be selected to fill the containment rail system 20 as desired.

Advantageously, the spill containment system 10 may be configured to have any desired shape or size. Figure 9 is a battery spill containment system formed in an L-shape. Figure 10 is a battery spill containment system formed in a U-shape. Figure 11 is a battery spill containment system formed in yet another shape. Again, any configuration of pillows 18 and socks 22 may optionally be used to suit the size, shape and configuration of the containment rail system 20.

Figure 12 is a perspective view of a pillow 18. The pillow 18 is preferably made from spunbound polypropylene material. When exposed to a flame, the pillow 18 also preferably melts instead of ignites. In this particular embodiment, the pillow 18 is fabricated out of a fabric and filled with a neutralizing material such as soda ash blended with an absorbent material such as vermiculite. In the alternative, any caustic base solution may be used. Thus, the pillow absorbs and retains moisture and also neutralizes acids. Optionally, a coloring agent may be added to the pillow 18 so that when acid contacts the pillow 18, the coloring agent soaks through the polypropylene fabric to alert personnel that an acid spill has occurred. The sock 22, illustrated in Figure 13, may be fabricated the same as a

pillow 18. Each pillow and sock may optionally be marked with an unique serial number for tracking purposes. The weight of a pillow 18, for example, may be 2.8 to 5 ounces, although other weights are certainly allowable.

Figure 14 is an exploded piece-part drawing of a small-sized battery spill containment system. The system comprises a containment rail system 20 formed by containment rails, an optional corrosion resistant liner 24, and an optional pillow 18 and/or sock 22.

Figure 15 is an exploded piece-part drawing of a battery spill containment system that uses a pad 44 and optional grid 46. The system comprises a containment rail system 20 formed by containment rails, a corrosion resistant liner 24, a pad 44 and a grid 46. Containment rails are mounted together to form the containment rail system 20. A corrosion resistant liner 24 is optionally inserted into the containment rail system 20. A pad 44, also shown in Figure 16, is placed into the corrosion resistant liner 24. The pad 44 is made of the same material and serves the same purpose as pillow 18 and sock 22. The pad 44 is essentially a thin pillow 18. The pad 44 is particularly suited for containing spills from valve regulated lead acid (VRLA) batteries because VRLA batteries do not leak as much as some other batteries and thus, the pads do not need to be as thick as the pillows. VRLA batteries do not leak as

much because they are typically sealed batteries and contain a gel instead of liquid acid. An optional grid 46 is then placed on top of the pad 44 in order to protect the pad 44 from the battery. The grid 46 may be made of a metal which may be corrugated for strength to hold heavy objects such as a battery. The metal grid also may be PVC coated to make it resistant to the spilled material. Alternatively, the grid 46 may be a perforated PVC sheet where the perforations allow the spilled substance to drip through and onto the pillows.

In this particular embodiment, the containment rail system 20 may have a height of three inches; the liner 24 may have a height of four inches; the pad 44 may have a thickness of a quarter inch; and the grid may be one-sixteenth of an inch thick. Of course, as with any of the embodiments and examples described in this patent specification, the dimensions, size, shape and/or configuration of the spill containment system and any of its components may be changed as desired for the particular application.

Figure 17 is a perspective closeup view of a containment rail system for a battery. The containment rail system 20 shown in Figure 17 is an integrally formed structure having compartments such as a compartment 50 to hold a battery or batteries and an optional compartment 52 to hold additional batteries. Compartments 50 and 52 are separated by an

optional ridge 56 which creates structural support so that the containment rail system can maintain its shape despite holding heavy batteries. Additional compartments may be added. Flanges 54 allow the containment rail system 20 to be mounted to other structures such as a battery rack. Figures 18 and 19 are a front edge view and a top view of the containment rail system of Figure 17.

Figure 20 is a perspective view of a battery spill containment system 10 that is holding batteries 14. As shown, the batteries rest on and are surrounded by socks 22. Alternatively, the socks 22 could be placed in any manner adjacent to the batteries 14.

Additional features are possible. For example, a leak detection device 60 may detect and indicate whether a leak or spill from a device has occurred. Figure 21 is an exploded piece-part view of a battery spill containment system 10, a leak detection device 60 and a battery rack 12. The containment rail system 20 may be any of the containment rail systems described in this patent specification. Preferrably, the containment rail system 20 is mounted to the floor. A corrosion resistant membrane or liner 24 is inserted into the containment rail system 20. A leak detection device 60 comprises a leak detector 62, a lead 64 and a leak indicator 66. The leak detector 62 may use any of a variety of known

methods to detect the presence of a leak or spill of any substance including water and acids. For example, one embodiment of the leak detector 62 is now described. In this example embodiment, the leak detector 62 may be a cotton sleeve that holds two conductor strands in close proximity to each other. Each of the conductor strands is wrapped by a braided fiberglass material so that the two conductor strands are not shorted together. One end of the two-conductor sleeve system is split so that one conductor connects to one end of a 3.9M ohm resistor while the other conductor connects to the other end of the resistor. The other end of the two-conductor sleeve system is also split where one conductor goes to a first lug inside the leak indicator 66 and the other conductor goes to a second lug inside the leak detector 66. Specifically, one embodiment of conductors uses seven conductors, 728 stranded, 20 aug. A current flows through the circuit formed by the two conductors and the resistor to the leak indicator 66. The cotton sleeve acts as a wick to draw fluids and liquids to the two conductors. Fluids that reach the conductors pass through the fiberglass material and contact the conductors, causing the conductors to short together. The shorting of the conductors decreases the effective resistance and increases the current flow. When the leak indicator 66 detects an increase in current or a decrease

in resistance across the first and second lugs, the leak indicator 66 determines that a leak or spill has occurred. The leak detector 62 preferably is able to detect leaks or spills that fall anywhere on liner 24. For example, the leak detector 62 may be in a coil or zigzag shape to cover a large area of the liner 24. Other configurations are possible and included within the scope of this invention. The leak detector 62 may be embedded into the liner 24 or simply rest on its surface. The leak detector 62 passes information about the presence or absence of a spill through a lead 64 to leak indicator 66. The leak indicator 66 indicates to personnel whether a spill or leak has occurred, through for example, an audible or visual alarm, or any other known mechanism for indicating the presence or absence of a condition. The leak detector 66 may optionally have a plurality of states that indicate the amount of spillage. For instance, if the leak detector 66 is based on an audible or visual alarm, the leak detector 66 may increase its audible alarm or flash more lights as the amount of spillage increases. Still further, the leak detector 66 may not only serve monitoring and indication functions, but also communication functions. For example, the leak detector 66 may communicate by radio frequency signals, infrared light, data over a fax/modem line, data over a telephone or other data line, or a direct

connection to a fire alarm, security guard station, or other alarming/monitoring systems. The leak detector 66 may have an electrical connection that permits (e.g., a dry "C" contact) customer communication with the site. Still alteratively, when the leak detector 66 detects a spill, or alternatively a severe enough spill, the leak detector 66 may cause certain events to occur, including but not limited to the issuance of an alarm to the proper personnel, the shutting off of equipment, or the diversion of power resources to other non-leaking batteries. The leak detection device 60 may be powered by AC current, its own battery source, or one of the batteries in the battery rack.

We now turn to the components that form a containment rail system 20. Figures 22-24 are a perspective view, a side edge view and a front view of a containment rail respectively. The containment rail 76 has a mounting flange 80 that has at least one hole 78. The hole 78 allows a screw, nail, or any other mounting device to mount the containment rail 76 to the floor or other structure. Of course, any of the dimension, size, shape and configuration of the containment rail may be changed to suit the particular application. The number of holes may be increased or decreased. If the mounting procedure relies on adhesive, the containment rail 76 may require no holes.

The containment rail 76 may be an adjustable containment rail 82, as shown in Figures 25-27. The adjustable containment rail 82 has a mounting flange 80 that has a plurality of holes 78. Each of the plurality of holes 78 is spaced from its neighboring hole by either a uniform amount or a non-uniform amount. Preferably, the plurality of holes 78 are spaced apart by a uniform amount so that the adjustable containment rails may be used to form a containment rail system of predetermined dimensions.

A corner containment rail is illustrated in Figures 28-30. The corner containment rail 88 may be used to form the corner of a containment rail system 20. The corner containment rail 88 has a mounting flange 80 and mounting holes 78. The corner containment rail may be a ninety degree corner, a sixty degree corner, a forty-five degree corner, or any other corner as desired. Again, as with any of the embodiments of any of the components or systems described in this patent specification, the dimensions, size, shape and/or configuration of the particular corner containment rail may be changed as desired for the particular application.

Figure 31 is a perspective view of another embodiment of a containment rail 100. Figures 32-34 depict the front view, side view and top view of the containment rail of Figure 31 respectively. The rail 100 has flanges and holes 78. The

dimensions, size, shape and/or configuration of the containment rail may be changed as desired for the particular application. Examples of such different embodiments are provided in Figures 35-38 and Figures 39-42. Other variations of the components of the containment rail system 20 are possible. For example, the containment rail 100 may have no flanges, one flange, two flanges, or more than two flanges. Often the number of flanges depends on the mounting requirements of the system. Figures 43-46 illustrate a containment rail 100 that has one flange, while Figures 31-42 depict containment rails having two flanges. As another example of a variation to the containment rail, Figures 47–50 illustrate a containment rail 100 having a notch 110. As discussed above, the notch 110 permits the building of an inverted containment rail system as shown in Figure 8.

Figures 52-55, 56-59 and 60-63 are views of a containment rail having slots. The slots allow the rail to be slidably mounted to the floor or other components to form a containment rail system of variable dimensions. The number, shape and dimensions of the slots may be changed as desired.

Figure 51 is a perspective view of a containment rail with components to mount the wall to the floor. A concrete floor is prepared according to the specification set forth by the American Society of Testing Materials (ASTM).

24

Specifically, the installer follows the ASTM specification for coating a concrete floor with epoxy to make the floor watertight. The proposed spill containment system preferably does not use adhesive to glue a spill containment system to the floor. Preferably instead, after the epoxy has dried, holes are drilled into the floor so that the spill containment system can be bolted to the floor. Bolting the system to the floor instead of gluing the system to the floor allows users to use battery lifting equipment. It is important to allow the normal use of battery lifting equipment because batteries in a battery rack must be serviced regularly and replaced as needed. Bolting rather than gluing the system to the floor also avoids the labor intensive nature of using an adhesive and waiting one to two days for the adhesive to cure.

While any mounting components may be used to secure the spill containment system to the floor, Figure 51 illustrates an example that uses a screw 120, optional washer 122, and optional floor anchor 124. An anchor punch tool 126 with its punching surface 128 may be used to create an appropriately sized hole in the floor so that the floor anchor 124 may be then inserted into the floor. The floor anchor 124 is inserted into the hole in the floor. The screw 120 is inserted into the washer 122, through the hole 78 and into the floor anchor 124. The purpose of the floor anchor 124 is to

increase the degree to which the screw 120 is secured to the floor. Thus, the floor anchor 124 also increases the integrity of the system if the system must hold the spilled substance during an emergency. Containment rails are bolted to one another to form a containment rail system. A sealant such as butyl rubber may be applied to all seams and holes to further create a watertight seal. This procedure for building a spill containment system can be used regardless if the system is for containing spills from a new or existing battery rack.

While the spill containment system has been proposed for containing acid spills from batteries, it can be used to contain spills from any device such as air conditioning units (which may leak water or freon), water heaters (which may leak water), or any other device. Moreover, it is not limited to containing and/or neutralizing acid spills as it can be used to contain and/or neutralize any kind of spill including a non-acidic spill.

While embodiments and implementations of the subject invention have been shown and described, it should be apparent that many more embodiments and implementations are within the scope of the subject invention. Accordingly, the invention is not to be restricted, except in light of the claims and their equivalents.